

- I. What is shading? - The process of generating synthetic imagery.
 - A. Every pixel in the final rendered image requires the following to be calculated:
 - 1. Surface Geometry
 - 2. Surface Attributes
 - 3. Surface Reflectivity
 - 4. Lighting

- II. Render Nodes
 - A. Along with shape nodes, transform nodes, and input nodes, render nodes are used to visualize renderable attributes of the modeling world.
 - 1. Can be Materials, textures, lighting, and atmospheric effects.
 - 2. Nodes appear in Hypergraph while using the Show Dependency mode.
 - B. Shading Groups - A network of render nodes that include some or all of the following:
 - 1. Materials - Determine the surface properties of an object.
 - i. Color and transparency.
 - ii. Matte or shininess, reflectivity
 - iii. Glow properties
 - iv. Motion Blur
 - 2. Textures - determine surface color by applying images, or procedural textures to surfaces.
 - 3. Placement Nodes - are used to determine placement and orientation of textures on objects.
 - 4. Bump or Displacement Nodes - determine the bump or displacement attributes on a surface.
 - C. Surface Material Render Nodes
 - 1. Anisotropic - used primarily for surfaces with microscopic grooves.
 - i. Direction and orientation of the tiny grooves to the camera eye determines the way in which light reflects off the surface.
 - ii. Examples - hair, cloth and brushed metal.
 - 2. Blinn - Used primarily for metallic surfaces which typically have soft specular highlights.
 - i. Used instead of Phong for surfaces that have bump or displacement maps.
 - ii. Softer highlights reduce flickering on thin highlights.
 - 3. Lambert - Used primarily for matte surfaces or other unpolished surfaces which have no specular highlights. Fastest to render.
 - 4. Phong / Phong E - Used primarily for glass and glossy plastic surfaces.
 - i. Faster to render than Blinn and Anisotropic.
 - ii. Phong E - slightly softer highlights and a simpler version of Phong.
(Think E for economy.)
 - 5. Layered Shader - a single surface material or texture composed of several different surface material and textures.
 - i. Require some level or portion of transparency on upper nodes to see lower nodes.
 - ii. Allows user to share attributes between layers of the shader. Subtle characteristics can be shared, resulting in a very natural looking effect.
 - 6. Surface Shader - Essentially like creating a new Shading Group.
 - i. Has only three input connections.
 - ii. Surface Material should be linked to a Material node.
 - iii. Displacement Material - connected to a material that will determine the displacement of the surfaces geometry.
 - III. Hypershade / Visor - Used to interactively create and graph dependency nodes of Shading Groups.
 - A. **Windows -> Visor** - A visual outliner and file browser. Displays images of shading nodes you can create, of those already in your scene, and those in your project folder.
 - B. Visor has three sections - they are:
 - 1. Rendering - displays the current scenes folders and their contents.
 - 2. Create -
 - i. Displays the equivalent of Create Render Node window.
 - ii. **MMB** drag from the Visor to Hypershade to create a new Render Node.
 - 3. Project Directory
 - i. Displays the contents of your current project directory and its subdirectories.

- ii. Drag images into the Hypershade to create new textures, or import from other projects.
- C. **Windows -> Hypershade** - used to create and edit rendering nodes, and to view and edit rendering or shading networks.
 - 1. Important menu options:
 - i. **Options -> Clear before graphing** - clears the display before redisplaying a newly selected or created node.
 - ii. **RMB -> Create -> X** - used to create render nodes such as materials, textures, lights, etc.
 - 2. Connecting input and output nodes.
 - i. **MMB Drag** - one node to another. You will get a dialog that asks what you want to link to what.
 - 3. Assigning Shader Groups to objects
 - i. **MMB Drag** - a Shading Group onto an object in a modeling world.
 - ii. Select a model in the world, then select a Shading Group node in the Hypershade. **RMB** over a render node, select **Assign material to Selection**.
 - iii. **Assign material to selection** can also be used to connect a render node to another render node.
 - 4. Hypershade icons -
 - i. Clear View - a small icon that looks like an eraser.
 - ii. Graph material to selected objects - looks like a small sphere and two boxes.
 - iii. Downstream graph - shows render nodes that are inputs into the selected node.
 - iv. Upstream graph - shows render nodes that are upstream of the selected node.
 - v. Downstream and upstream graph - displays the entire dependency graph of the selected render node.
- IV. Defining Material Properties - open up a Render Nodes' Attribute Editor
 - A. Color - Generally determined by three values representing the three primary colors Red, Green, and Blue.
 - 1. HSV or RGB - The "color" of the color. (e.g. one red may have more blue in it than red)
 - 2. Saturation - The amount of hue in a color.
 - i. A color can go from dull to brilliant.
 - ii. A fully desaturated color is a tone of gray.
 - iii. Slider next to Gamut is used to determine saturation.
 - 3. Luminance - The brightness of a color. (e.g. a color can be lighter or darker)
 - B. Specular - Cleverly referred to as "how light reflects off the surface"
 - 1. Diffuse - The measure of how much light reflects overall from a surface.
 - i. Darker objects reflect less light - lower diffuseness.
 - ii. Higher diffuseness objects will be brighter than an object of the same color, though less diffuse.
 - iii. An object with only the diffuse parameter renders as perfectly matte.
 - 2. Specularity - The shiny spot on an object. (BLINN and PHONG)
 - i. Specular Color - The color of the specular highlight.
 - ii. Shininess / Eccentricity - effects the size of the highlight.
 - 1. Smaller highlights mean more shiny.
 - 2. Large highlights make light more scattered and less shiny.
 - 3. Reflectivity - not all materials are equally reflective, use this to set reflectivity.
 - C. Special Surface Effects
 - 1. Transparency - How much you can see through an object.
 - i. Not all shading models support transparency.
 - ii. Higher transparency values dim highlights, so adjustments should be made.
 - 2. Refraction - How light bends as it passes through transparent objects.
 - i. Generally only available in Raytracing/Radiosity rendering.
 - ii. Refraction index - Air has an index of 1, light simply passes through without bending. Settings other than 1 create distortions as you look through the material.
 - 3. Incandescence - Makes it appear that an object is emitting light.

Note: This doesn't effect the lighting in the scene or other objects nearby.
 - 4. Translucence - The way that light diffusely penetrates through translucent objects.